DECLARATION

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Kaoru Tasaka

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MAGENTIC DISK APPARATUS

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SPECIFICATION

1. Title of the Invention

MAGNETIC DISK APPARATUS

2. What is Claimed is:

1. A magnetic disk apparatus comprising:

a magnetic disk;

a magnetic head;

a read/write function for writing data to the magnetic disk and for reading data from the magnetic disk;

a positioning control mechanism of the magnetic head;

a rotation control function for rotating the magnetic disk; and

a data control function for controlling data between an external system and the magnetic disk apparatus, wherein a board on which a magnetic disk controlling electric circuit is mounted is a part of a case which encloses said magnetic disk, said magnetic head and said positioning control mechanism of the magnetic head.

2. A magnetic disk apparatus comprising:

a magnetic disk;

a magnetic head;

a read/write function for writing data to the magnetic disk and for reading data from the magnetic disk;

a positioning control mechanism of the magnetic head;

a rotation control function for rotating the magnetic disk; and

a data control function for controlling data between an external system and the magnetic disk apparatus, wherein a board, on which a magnetic disk controlling electrical circuit is mounted, is made to be film-like so as to mount electronic parts thereon.

3. A magnetic disk apparatus as defined in claim 1 or 2, wherein the outer diameter of said magnetic disk is about 1.7 inches.

4. A magnetic disk apparatus as defined in claim 1 or 2, further comprising a recording/reproducing system change means which changes the frequency or the like of a read/write clock according to a data access position of said magnetic head.

5. A magnetic disk apparatus as defined in claim 1 or 2, further comprising a means for changing the rotation speed of said magnetic disk.

6. A magnetic disk apparatus as defined in claim 1 or 2, further comprising a head positioning control means which includes a data-surface servo method so as to realize a track density of at least 2500 TPI (Track Per Inch).

7. A magnetic disk apparatus as defined in claim 1 or 2, further comprising a head positioning control means which includes a servo-surface servo method so as to realize a track density of at least 2500 TPI.

8. A magnetic disk apparatus as defined in claim 1 or 2, further comprising a head positioning control means which uses a servo-surface servo method in a case where said magnetic head moves from a current track to a target track (hereinafter, seeking), and uses a data-surface servo method in a case where said magnetic head follows the target track (hereinafter, following), so as to realize a track density of at least 2500 TPI.

9. A magnetic disk apparatus as defined in claim 1 or 2, further comprising a head positioning control means which uses a servo-surface servo method and a data-surface servo method, in combination, so as to realize a track density of at least 2500 TPI.

10. A magnetic disk apparatus as defined in claim 1 or 2, wherein the rotary moving method or the linear moving method is adopted as a moving method of said magnetic head.

11. A magnetic disk apparatus as defined in claim 1 or 2, wherein the rotary moving method, in which a rotary head axis is aligned with the center of the rotation of an

applied force, is adopted as a moving method of said magnetic head.

12. A magnetic disk apparatus as defined in claim 1 or 2, wherein said magnetic disk apparatus measures about 12 mm in height.

13. A magnetic disk apparatus as defined in claim 1 or 2, wherein said magnetic disk apparatus measures about 73 mm in width and about 51 mm in depth, respectively.

14. A magnetic disk apparatus as defined in claim 1 or 2, wherein said disk drive apparatus has a built in disk and has a storage capacity of not less than 40 MB.

15. A magnetic disk apparatus as defined in claim 1 or 2, wherein power supply voltage from the external system to said magnetic disk apparatus is a single power source voltage of about 5 V.

16. A magnetic disk apparatus as defined in claim 1 or 2, wherein power supply voltage from the external system to said magnetic disk apparatus is a single power source voltage of about 3.3 V.

17. A magnetic disk apparatus as defined in claim 1 or 2, wherein a power terminal for receiving a voltage supplied

from the external system is provided to a signal connecting unit which electrically connects control signals of the external system and the magnetic disk apparatus and a data signal.

18. A magnetic disk apparatus as defined in claim 1 or 2, wherein the power supply from the external system to the magnetic disk apparatus is supplied separately to an analog circuit and a digital circuit.

19. A magnetic disk apparatus as defined in claim 1 or 2, wherein a spindle motor for rotating the magnetic disk has an outer hub type structure and has an outer wheel rotating type or an inner wheel rotating type.

20. A magnetic disk apparatus as defined in claim 1 or 2, wherein a spindle motor for rotating the magnetic disk has an inner hub type structure and has an outer wheel rotating type or an inner wheel rotating type.

21. A magnetic disk apparatus as defined in claim 1 or 2, wherein said electronic circuit is disposed on the same board.

22. A magnetic disk apparatus as defined in claim 1, wherein the board as defined in claim 21 also has a function of a supporting member for the spindle motor shaft.

23. A magnetic disk apparatus as defined in claim 21, wherein a signal connecting unit is disposed on the board.

24. A magnetic disk apparatus as defined in claim 1 or 2, further comprising:

a read/write signal processing LSI for writing and reading data to and from the disk;

a data control LSI for controlling data fed to and from an external system;

an actuator control LSI for controlling the positioning of the magnetic head and the rotation of the spindle motor;

a microcomputer for managing the control of the entire apparatus; and

a RAM/ROM for storing the data.

3. Detailed Description of the Invention

(Industrial Field of Utilization)

This invention relates to a magnetic disk apparatus, in particular, a small, high capacity magnetic disk apparatus with low power consumption.

(Prior Art)

As is disclosed in PCT/WO89/08313, a conventional small magnetic disk apparatus comprises one or more magnetic disks which are about 2.5 inches in size. A rotary actuator

mechanism, a magnetic head positioning servo mechanism, a power saving means and so on are also mentioned therein.

Specifically, the rotary actuator mechanism includes an arm assembly having a cam follower for dynamically loading and unloading the magnetic head.

The servo mechanism enhances the accuracy of head positioning by reducing an external force toward the servo actuator and includes hardware and software for saving power consumption.

The other prior art is disclosed in the Japanese Unexamined Patent Publication No. SHO 62-256295.

(Problems that the Invention Is to Solve)

The above-mentioned prior art has not taken into consideration such developments as miniaturization to less than 2.5 inches in size, high density recording, rotational speed of a spindle motor, control method and power supply method. There have been problems in mounting space and power consumption of the magnetic disk apparatus and the performance of an electronic circuit.

It is an object of the present invention to provide a small magnetic disk apparatus which is applicable to a small information processing system, such as a note book type personal computer or a palm top personal computer.

It is another object of the present invention to provide a lower power consumption, including a power voltage

supply method to a small magnetic disk apparatus, and a higher performance electronic circuit.

It is a further object of the present invention to provide a high capacity magnetic disk drive apparatus.

(Means for Solving the Problems)

To accomplish this object, there is provided a board, on which an electronic circuit for controlling a magnetic disk is mounted, as a part of a case of a magnetic disk apparatus. Furthermore, the board on which the electronic circuit for controlling the magnetic disk is mounted is made to be film-like so as to be enclosed in or attached outside the case of the magnetic disk apparatus. The magnetic disk is about 1.7 inches in outer diameter.

Recording/reproducing system changing means is provided for changing the frequency of the read/write clock depending upon the data access position of the magnetic head. A means for changing the rotational speed of the magnetic disk is also provided. As a magnetic head positioning control method, the servo-surface servo method or the data-surface servo method is adopted. The head positioning control method is the servo-surface servo method at seeking time and is the data-surface servo method at following time. The head positioning control method may be a combination of the servo-surface servo method and the data-surface servo method. As a head moving method used for head positioning control, the rotary moving method or the linear moving

method is adopted. If the head moving method used for head positioning control is the rotary moving method, a rotary axis of the head is aligned with the center of rotation of force.

The magnetic disk apparatus is about 12 mm in height, about 73 mm in width and about 51 mm in depth. One disk of the magnetic disk apparatus has a storage capacity of not less than 40 MB. The power source supply from an external system to the magnetic disk apparatus is about 5 V single power source voltage or, alternatively, about 3.3 V single power source voltage.

A power source terminal for receiving the power supply voltage from the external system is provided to the signal connecting unit for electrically connecting the control signal and the data signal of the magnetic disk apparatus and the external system. The power from the external system to the magnetic disk apparatus is separately supplied to analog circuits and digital circuits.

A spindle motor for rotating the magnetic disk has an outer hub type structure and is an outer wheel rotating type or an inner wheel rotating type. Alternatively, the spindle motor has an inner hub type structure and is an outer wheel rotating type or an inner wheel rotating type. Electronic circuits are disposed on the same board. The electronic circuit board has a function of a member for supporting a spindle motor shaft of the rotating means. A signal connecting unit is disposed on the electronic circuit board.

The electronic circuit comprises a read/write signal processing LSI for writing and reading data to and from the disk, a data control LSI for controlling data fed to and from and external system, an actuator control LSI for controlling the positioning of the magnetic head and the rotation of the spindle motor, a microcomputer for managing the control of the whole of the apparatus and a RAN/ROM for storing the data.

(Operation)

In order to realize miniaturization of the magnetic disk apparatus, the board, on which a magnetic disk controlling electronic circuit is mounted, forms a part of a case of a magnetic disk apparatus. The magnetic disk controlling electronic circuit may be disposed in a free space of the magnetic disk apparatus by mounting the circuit on a film-like board. It will suffice to use a small magnetic disk having an outer diameter of about 1.7 inches for recording data, in order to achieve the miniaturization. Even if the magnetic disk is miniaturized, the linear recording density and track density may be increased to provide a high storage capacity. In order to accomplish this, the linear recording density is made as constant as possible and the storage capacity is increased by adopting a recording method (zone bit recording) in which writing frequency is changed in the radial direction of the magnetic disk. Accordingly, the magnetic disk apparatus includes a

recording/reproducing system changing means for changing the read/write clock frequency depending upon the data access position. This may be achieved by changing the rotational speed of the spindle motor for rotating the magnetic disk. The means for changing the rotational speed contributes to a reduction in the power consumption of the magnetic disk apparatus by reducing or stopping the rotation of the disk when it is unnecessary.

Head positioning control achieves at least 2500 TPI using the servo-surface servo method. Alternatively, the data-surface servo method may be used. On seeking, the servo-surface servo method may be used, and on following, the data-surface servo method may be used. A combination of the servo-surface servo method and the data-surface data method may be used. In order to achieve miniaturization and high precision, the magnetic head is moved by either the rotary moving method or the linear moving method. When the head positioning is controlled by the head rotary moving method, a rotary moving method in which a rotary head axis is aligned with the center of the rotation of an applied force may be adopted to enhance the control performance by suppressing the residual vibrations at following time.

Furthermore, in order to achieve miniaturization, the magnetic disk apparatus measures about 12 mm in height, about 73 mm in width and about 51 mm in depth. In order to achieve miniaturization and high capacity, the magnetic disk apparatus has a built-in magnetic disk and has a storage

capacity of not less than 40 MB. In order to achieve simplification of the power source of the external system and low power consumption of the magnetic disk apparatus, a supply voltage of about 5 V or 3.3 V is adopted. A power source terminal for receiving voltage supply from the external system is provided to a signal connecting unit which electrically connects the control signal and the data signal of the external system and the magnetic disk apparatus. The electronic circuit for controlling the magnetic disk apparatus is stabilized by supplying the power supply source separately to analog and digital circuits.

In order to realize miniaturization of the magnetic disk apparatus, a spindle motor may have an outer hub type structure and may be an outer wheel rotating type or an inner wheel rotating type. Alternatively, the spindle motor may have an inner hub type structure and may be an outer wheel rotating type or an inner wheel rotating type. In order to realize miniaturization of the magnetic disk apparatus, electronic parts, on which the magnetic disk controlling electronic circuit is mounted, are mounted on the same board. The board also has a function of a supporting member of a spindle motor shaft. Furthermore, a signal connecting unit is disposed on the board.

In order to realize miniaturization of the magnetic disk apparatus, the electronic circuit comprises a read/write signal processing LSI for writing and reading data to and from the magnetic disk, a data control LSI for

controlling data fed to and from an external system, an actuator control LSI for controlling the positioning of the magnetic head and the rotation of the spindle motor, a microcomputer for managing the control of the entire apparatus and a RAM/ROM for storing the data.

(Embodiments)

Now, a case where an embodiment of the present invention is applied to a microminiature magnetic disk apparatus will be described with reference to FIGs. 1-8.

FIG. 1 is an exploded perspective view 1 of a microminiature magnetic disk apparatus. The apparatus comprises a mechanism 1 and an electronic circuit 2 which controls the mechanism 1. The mechanism comprises a magnetic disk 3 for storing data, a magnetic head 4 for writing and reading data to or from the magnetic disk 3, a spindle motor 5 for rotating the magnetic disk 3, a guide arm 6 for supporting the magnetic head, a VCM (Voice Coil Motor) 7 for moving the magnetic head 4, a case 8 for encasing the aforementioned components (the magnetic disk 3 to the VCM 7) and an electronic circuit board 9 for controlling the aforementioned components, that is, the magnetic disk 3 to the VCM 7. The electronic circuit board 9 constitutes a part of the case 8 for encasing the mechanism 1. Accordingly, the board also functions as a member for supporting each mechanism 1 so that the magnetic disk apparatus can be miniaturized. If the circuit board 9

is made of ceramic having an excellent heat dissipating ability, miniaturization of the circuit can be achieved by directly mounting LSI chips on the board in a bare chip manner without encasing LSI chips in packages. Since the circuit board is large in size in comparison with the LSI package, it will become easier to thermally design the LSI. In accordance with the present embodiment, a microminiature magnetic disk apparatus which is suitable for incorporation into an apparatus can be provided.

FIG. 2 is an exploded perspective view 2 of the microminiature magnetic disk apparatus of the present invention. The apparatus comprises a mechanism 1 and an electronic circuit 2 which controls the mechanism. The mechanism 1 is identical, in structure, with that shown in FIG. 1. An electronic circuit board 9 is in the form of film on which electronic components are mounted. This packaging enables the components to be received in a free space of the case of the magnetic disk apparatus so that miniaturization of the magnetic disk apparatus is achieved. In consideration of the thermal radiation of the electronic circuit, the circuit board may be provided outside the case of the magnetic disk apparatus or, alternatively, provided in a free space in an external system into which the magnetic disk apparatus is incorporated. According to the present embodiment, a microminiature magnetic disk apparatus, which is suitable for being incorporated into an apparatus, can be provided.

FIG. 3 is a block diagram of the microminiature magnetic disk apparatus of the present invention. The apparatus comprises a mechanism 1 and an electronic circuit 2 for controlling the mechanism 1. The block diagram shows the circuit configuration of the electronic circuit 2. The mechanism 1 comprises a magnetic disk 3 for storing data, a magnetic head 4 for writing and reading data to or from the magnetic disk 3, a spindle motor 5 for rotating the magnetic disk 3, a guide arm 6 for supporting the magnetic head, a VCM (voice coil motor) 7 for moving the magnetic head 4, a case 8 for encasing the aforementioned components (the magnetic disk 3 to the VCM 7) and an electronic circuit board 9 for controlling the aforementioned components, that is, the magnetic disk 3 to the VCM 7. The electronic circuit 2 for controlling the mechanism comprises a read/write function unit 10 for writing and reading data onto and from the magnetic disk 3, a magnetic head positioning control for controlling the position of the magnetic head 4 to a target track, a mechanism control 11 for controlling the rotational speed of the magnetic disk 3, and a data control 12 for controlling the data fed between the read/write function unit 10 and an external system. Each unit is formed as follows: The read/write function unit 10 comprises a R/W amplifier 23 for recording and reproducing data on and from the magnetic disk -3, a waveform shaping circuit 14 for shaping the waveform of the read signal from the magnetic disk, a data separator 15 for

extracting a reference clock from the read waveform shaped at the waveform shaping circuit, and a discriminating circuit 16 for converting the codes recorded on the magnetic disk into NRZ codes based upon the waveform shaped by the waveform shaping circuit and the reference clock, and for converting NRZ signals fed from the data control 12 into codes which are suitable for recording on the magnetic disk. The mechanism control 11 comprises a positional signal generating circuit 17 for generating positional information from the positioning signal of the magnetic head 4, which is read out of the magnetic head 4, a head positioning control circuit 18 for controlling the positioning of the magnetic head 4 in response to the positional information, a motor driver 19 for feeding the output of the head positioning control circuit 18 to the VCM 7, a spindle motor control/driver 20 for controlling the rotational speed of the spindle motor and a write clock generating circuit 21 for feeding write clocks to the read/write function unit 10 from the output of the positional signal generating circuit 17. The data control 12 comprises a SCSI (Small Computer System Interface) controller 22 for controlling the SCSI protocol which is standard for the transfer of data to and from an external host, an HDC (Hard Disk Controller) 23 for converting parallel data from an external system into data (generally serial data) suitable for recording and reproducing on and from the magnetic disk 3, a buffer RAM 24 for adjusting the difference in the data transfer rate

between the external host and the HDC 23 and the data transfer rate between the HDC 23 and the magnetic disk 3, and a CPU 25 for controlling all units in the magnetic disk apparatus. A large quantity of data can be stored on the magnetic disk 3 by making the external dimension of the magnetic disk 3 about 1.7 inches and by providing a means for changing the frequency of the read clock generated by the data separator and the frequency of the write clock of the write clock generating circuit 21 depending upon the reading and writing position of the magnetic head 4. Low power consumption can be achieved by providing the spindle motor control/driver 20 with a means for changing the rotational speed of the magnetic disk 3. Recording of a large quantity of data on the magnetic disk 3 may be provided by using the means for changing the rotational speed without providing means for changing the frequency of the clock for recording and reading data on and from the magnetic disk 3. In order to record a large quantity of data on the magnetic disk 3, the track density is made not less than 2500 TPI (Tracks Per Inch). This can be achieved by providing a magnetic head positioning control circuit 18 adopting a data-surface servo method in which the magnetic head for reading the positioning signal of the magnetic head is the same magnetic head used for reading and writing data. Of course, in order to achieve the above track density, the servo-surface servo method, or the servo-surface servo method and the data-surface servo method may be used at

seeking and following times, respectively. Alternatively, a combination of the servo-surface servo method and the data-surface servo method may be used. According to the present embodiment, a microminiature, high capacity and low power consumption magnetic disk apparatus, which is suitable for being incorporated into an apparatus can be provided. In FIG. 3, although the VCM, which is a rotary moving type, is used as a system for moving the magnetic head, it is also possible to use a linear motor which is a linear moving type.

FIG. 4 is a view showing the mechanism of the VCM 7 of the microminiature magnetic disk apparatus of the present invention. The VCM 7 comprises a magnetic head 4, a gimbal 26, a guide arm 6, a balancer 27, a coil 28, a magnet 29 and a carriage 30. The balancer statically balances with a rotary shaft and the total mass of the magnetic head, the gimbal and the guide arm. The coil 28 is provided so that the center of the rotary shaft is aligned with the center of an applied force. If the center of the rotary shaft is not aligned with the center of the applied force, the rotary shaft is struck upon driving of the VCM 7 to cause the tip end of the magnetic head 4 to oscillate. The oscillation at following time lasts for a considerable period of time. Accordingly, the control performance is degraded. Since, in the present embodiment, the center of the rotary shaft is aligned with the center of force, the residual oscillation at following time can be remarkably reduced to enhance the

control performance. According to the present invention, a microminiature magnetic disk apparatus, which is suitable for being incorporated into an apparatus in which the control performance for positioning the magnetic head is remarkably enhanced, can be provided.

FIG. 5 is a perspective view 1 of the microminiature magnetic disk apparatus of the present invention. Today, more compact and light weight microminiature magnetic disk apparatus have been in demand to fulfill demands for compact and light weight machines such as portable personal computers. Accordingly, the size of the magnetic disk apparatus mounted on the handy computer is about 12 mm in height, about 73 mm in width and about 51 mm in depth. Since the magnetic disk apparatus is only 12 mm in height, only one magnetic disk is mounted. The magnetic disk is capable of storing at least 40 MB in view of the processing capacity of the personal computer on which the magnetic disk apparatus is mounted.

Power source voltage for supplying power to the magnetic disk apparatus is a single power source voltage, which is currently and widely most used in small size office automation equipment.. The voltage of the power source is about 5 V or about 3.3 V, which is capable of driving the microminiature magnetic disk apparatus.

The method of supplying the power source voltage to the microminiature magnetic disk apparatus is the same as the method of supplying the power source voltage to the DIP type

of existing TTL devices. Specifically, the power supplying terminals 31 and 32 are located at the left and upper edge and the right and lower edge of the drive, respectively, as viewed from an upper position when the longitudinal side of the drive is horizontal. One terminal 31 is Vcc, while the other terminal 32 is Vss. This prevents users from mistaking the terminals on designing or mounting of the board.

According to the present embodiment, a microminiature, high capacity and low power consumption magnetic disk apparatus, which is suitable for being incorporated into equipment can be provided. Since the power source terminals for receiving voltage supplied from the external system are provided on the electrical connection for transmitting and receiving control and data signals to and from the external system, a microminiature magnetic disk apparatus occupying less space for connection with the external system can be realized.

FIG. 6 is a perspective view 2 showing the microminiature magnetic disk apparatus. A specific method of supplying power to the microminiature magnetic disk apparatus is shown in the figure. As shown in FIG. 6, if a flat parallel cable is used, an external system and a signal connector 33 are provided with a power cable 35 for receiving power from the external system, in accordance with a control signal/data signal cable 34. Use of a keyed flat cable connector prevents the apparatus from being broken by

the application of an abnormal voltage due to misinsertion of the connector. Since the electric connector for inputting and outputting control signals and data signals to and from the external system has the power terminals for receiving a voltage supplied from the external system, a microminiature magnetic disk apparatus occupying less space for connection with an external system can be provided. Analog and digital circuits may be separately powered in order to stabilize the operation of the electronic circuits of the magnetic disk apparatus.

FIG. 7 shows a spindle motor of the microminiature magnetic disk apparatus. The spindle motor 5 is of an outer hub and outer wheel rotating type. A circuit board also functions as a member for supporting a spindle motor shaft. According to the present embodiment, miniaturization of the spindle motor 5 can be achieved and the shaft torque can be increased. Accordingly, a microminiature magnetic disk apparatus having the effect of reducing rotation fluctuation can be provided. Of course, the spindle motor 5 may be of the outer hub and inner wheel rotating type, or the inner hub and outer wheel rotating type, if miniaturization and stabilization of the rotation can be achieved.

FIG. 8 is an exploded perspective view of an electronic circuit board of a microminiature magnetic disk apparatus. The circuit board has a signal connecting unit 26. The electronic circuit includes a read/write signal processing LSI 37 for writing and reading data to and from the magnetic

disk, a data control LSI 38 for controlling the data fed to and from an external system, and actuator control LSI 39 for controlling the positioning of the magnetic head and the rotation of the spindle motor 5, a microcomputer 40 for managing the control of the entire apparatus, and RAM 41/ROM 42 for storing data. Since signal connection units and electronic circuits are formed on one circuit board in accordance with the present embodiment, a microminiature magnetic disk apparatus can be realized.

(Effect of the Invention)

According to the present embodiment, since a board on which a magnetic disk controlling electronic circuit is mounted is used as a part of a case of a magnetic disk apparatus or a film-like board on which the magnetic disk controlling electronic circuit is mounted is disposed in a free space of the magnetic disk apparatus, miniaturization of the magnetic disk apparatus is achieved and the apparatus has an effect of being suitable for incorporation into equipment.

The magnetic disk apparatus is made about 1.7 inches in outer diameter and comprises a recording/reproducing system changing means for changing the frequency of the read/write clock depending upon the data access position, a head positioning control means having a data-surface servo method for making the track density not less than 2500 TPI and a means for changing the rotational speed of the magnetic

disk. Thus, a microminiature, high capacity and low power consumption magnetic disk apparatus, which is suitable for incorporation into equipment, is provided. Of course, if the positioning control performance is obtained, the positioning control method may be the servo-surface servo method, or the servo-surface servo method at seeking time and the data-surface servo method at following time, or, alternatively, a combination of the servo-surface servo method and the data-surface servo method.

By adopting the rotary moving method, in which a drive unit requires less area, or the linear moving method, in which no offset angle of the magnetic head exists and high head positioning performance is readily obtained, as the head moving method, a microminiature, high capacity magnetic disk apparatus, which is suitable for incorporation into equipment can be provided.

By adopting the rotary moving method, in which the rotary axis of the magnetic head is aligned with the center of force, as the head moving method, residual vibration which occurs when the head is moved can be remarkably reduced so that enhancement in following accuracy and shortening of access time can be achieved. Accordingly, a microminiature magnetic disk apparatus having high capacity can be provided.

By making the magnetic disk apparatus about 12 mm in height, the apparatus becomes very small so as to be suitable for incorporation into equipment.

By making the magnetic disk apparatus about 73 mm in width and about 51 mm in depth, a microminiature, high capacity magnetic disk apparatus, which is suitable for incorporation into equipment, can be provided.

If the magnetic disk apparatus includes one disk having a storage capacity not less than 40 MB, a microminiature, high capacity magnetic disk apparatus, which is suitable for incorporation into equipment, can be provided.

By setting the power supply voltage from an external system to the magnetic disk apparatus to a single power source voltage of about 5 V, since the voltage is generally used in small OA equipment, which is a power supplying device, the magnetic disk apparatus is suitable for incorporation into equipment.

By setting the power supply voltage from an external system to the magnetic disk apparatus to a single power source voltage of about 3.3 V, since the voltage is generally used in small OA equipment, which is a power supplying device, the magnetic disk apparatus is suitable for incorporation into equipment.

By providing the signal connecting unit for electrically connecting the control signal of the external system and the magnetic disk apparatus and the data signal with a power terminal for receiving the power supply voltage from the external system, the space for connection with the external system can be reduced so that the magnetic disk apparatus is suitable for incorporation into equipment.

In the magnetic disk apparatus, by supplying the power source supply voltage from the external system to the magnetic disk apparatus separately to analog and digital circuits, the performance of the electronic circuit of the magnetic disk apparatus can be improved.

If the spindle motor for rotating the magnetic disk has an outer hub type structure and is of an outer wheel rotating type or an inner wheel rotating type, the rotation of the magnetic disk can be stabilized by miniaturization of the spindle motor and an increase in shaft torque.

If the spindle motor for rotating the magnetic disk has an inner hub type structure and is of an outer wheel rotating type or an inner wheel rotating type, the rotation of the magnetic disk can be stabilized by miniaturization of the spindle motor and an increase in shaft torque.

By disposing the electronic circuits on the same board as the magnetic disk apparatus, a saving in space on the electronic circuit board can be achieved and the magnetic disk apparatus is suitable for incorporation into equipment.

If the board also functions as a support member for the spindle motor shaft, the spindle motor can be miniaturized and the magnetic disk apparatus becomes suitable for incorporation into equipment.

If the signal connecting unit is disposed on the electronic circuit board, a saving in board space can be achieved and the magnetic disk apparatus becomes suitable for incorporation into equipment.

The electronic circuit of the disk drive apparatus comprises a read/write signal processing LSI for writing and reading data to and from the disk, a data control LSI for controlling data fed to and from an external system, an actuator control LSI for controlling the positioning of the magnetic head and the rotation of the spindle motor, a microcomputer for managing the control of the entire apparatus and a RAM/ROM for storing data. Accordingly, saving in space for the electronic circuit can be achieved and the magnetic disk apparatus is suitable for incorporation into equipment.

(Brief Description of the Drawings)

FIG. 1 is an exploded perspective view of an embodiment of a microminiature magnetic disk apparatus of the present invention;

FIG. 2 is an exploded perspective view of another embodiment of the microminiature magnetic disk apparatus of the present invention;

FIG. 3 is a block diagram of an embodiment of the microminiature magnetic disk apparatus;

FIG. 4 is a view showing the structure of a VCM of the microminiature magnetic disk apparatus of the present invention;

FIG. 5 is a perspective view of an embodiment of the microminiature magnetic disk apparatus of the present invention;

FIG. 6 is a perspective view of another embodiment of the microminiature magnetic disk apparatus of the present invention;

FIG. 7 is a structural view of a spindle motor of the microminiature magnetic disk apparatus of the present invention;

FIG. 8 is an exploded perspective view of an electronic circuit board of the microminiature magnetic disk apparatus of the present invention.

(Description of the Marks)

1: mechanism

2: electronic circuit

3: magnetic disk

4: magnetic head

5: spindle motor

7: VCM

9: electronic circuit board

10: read/write function unit

11: mechanism control

12: data control

ABSTRACT

Abstract

Object

The present invention relates to a magnetic disk apparatus, specifically, a small, high capacity and low power consumption magnetic disk apparatus.

Structure

A controlling electronic circuit board 9 of a magnetic disk apparatus is used as a part of a case which encloses a mechanism, and a magnetic disk 3 is made about 1.7 inches in an outer diameter and the magnetic disk apparatus 3 is 12 mm × 73 mm × 51 mm in height, width and depth. A signal connecting unit, which electrically connects the control signal of an external system and the magnetic disk apparatus and the data signal, is provided on the same board as the electronic circuit board 9. A power source terminal for receiving a single power source of 5 V or 3.3 V, which is the power supply voltage from the external system, is provided on the signal connecting unit.

Effect

According to the above structure, the magnetic disk apparatus becomes microminiature with high capacity and low power consumption, and is suitable for incorporation into equipment.

Selected Drawings

Fig. 3

FIG. 1

EXPLODED PERSPECTIVE VIEW 1 OF A MICROMINIATURE MAGNETIC DISK APPARATUS

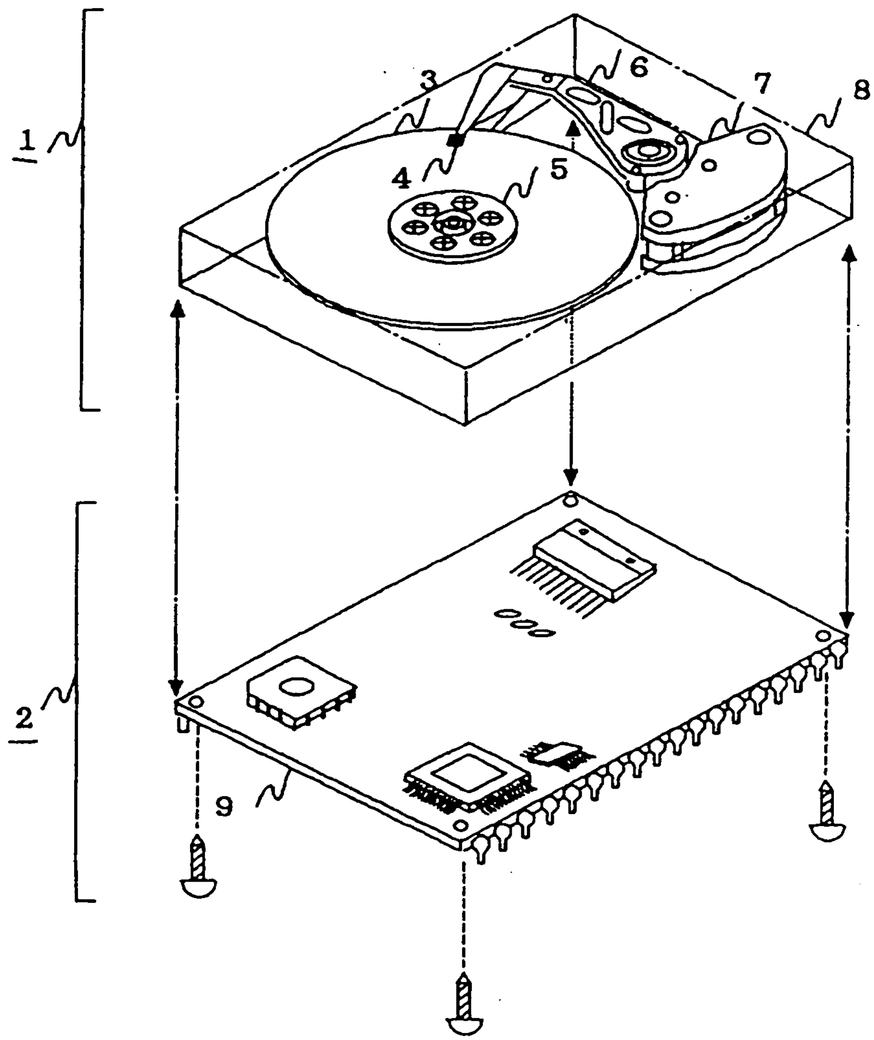

FIG. 2

EXPLODED PERSPECTIVE VIEW 2 OF THE MICROMINIATURE MAGNETIC DISK APPARATUS

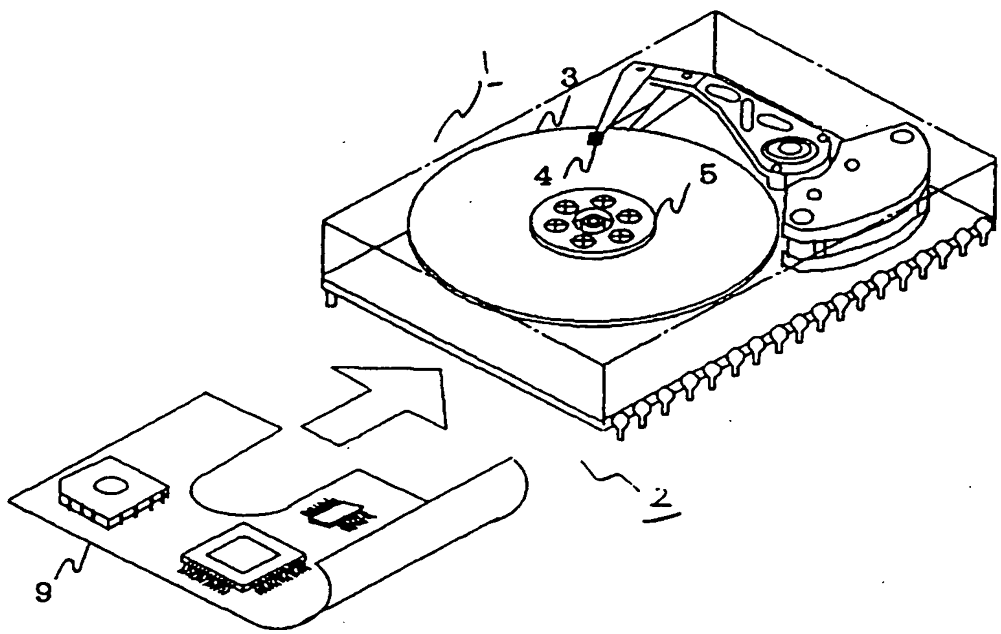

FIG. 3

BLOCK DIAGRAM OF

THE MICROMINIATURE MAGNETIC DISK APPARATUS

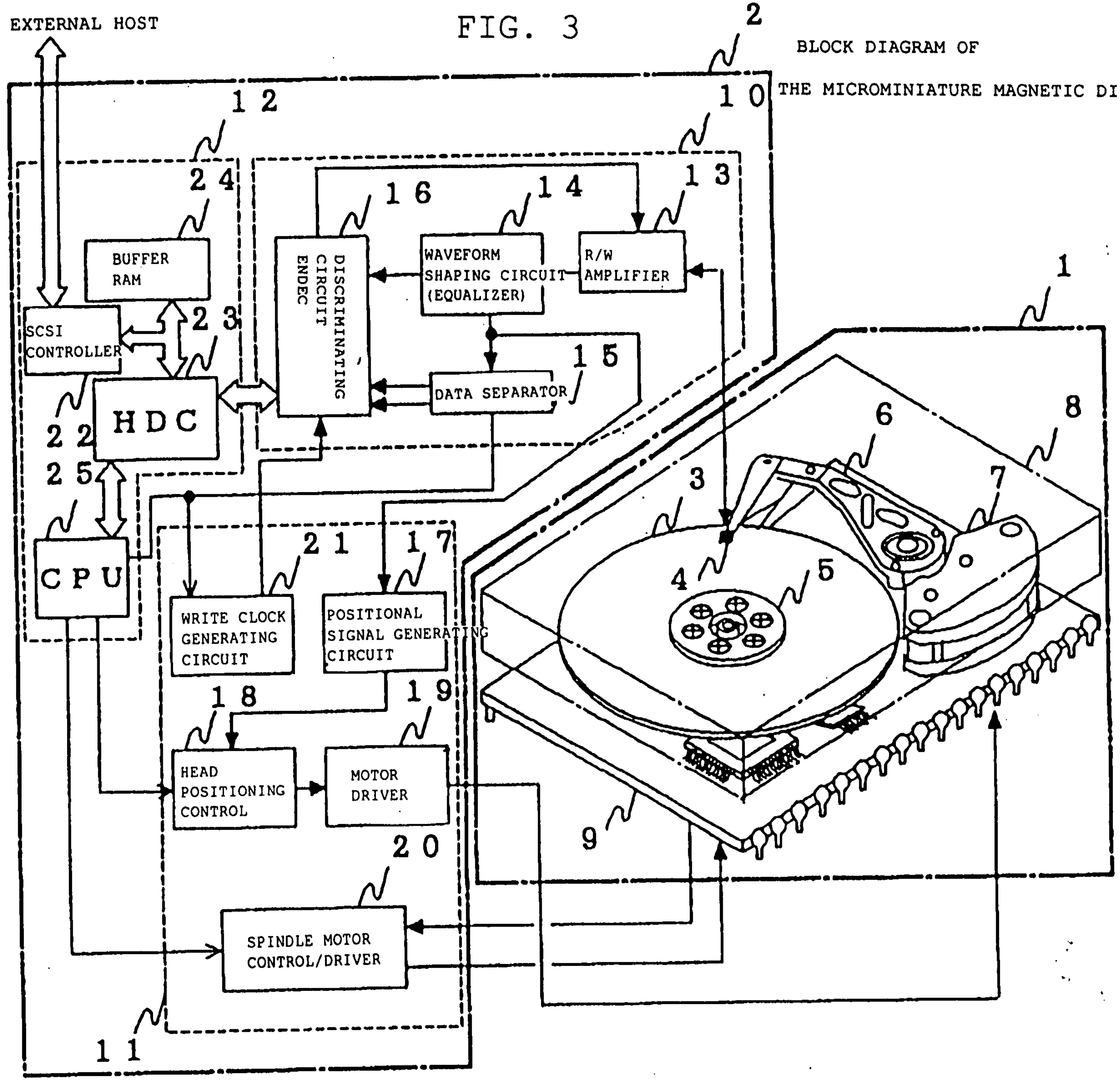

FIG. 4

STRUCTURE OF A VCM OF THE MICROMINIATURE MAGNETIC DISK APPARATUS

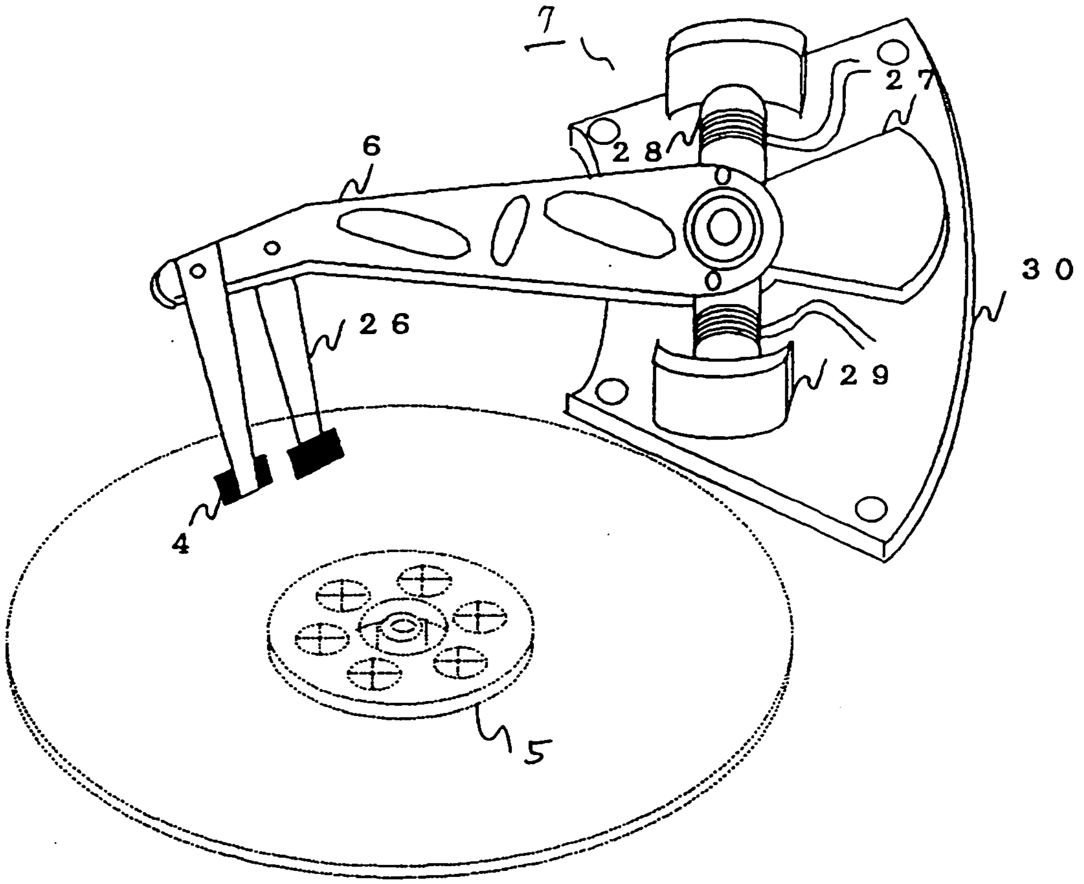

FIG. 5

PERSPECTIVE VIEW 1 OF THE MICROMINIATURE MAGNETIC DISK APPARATUS

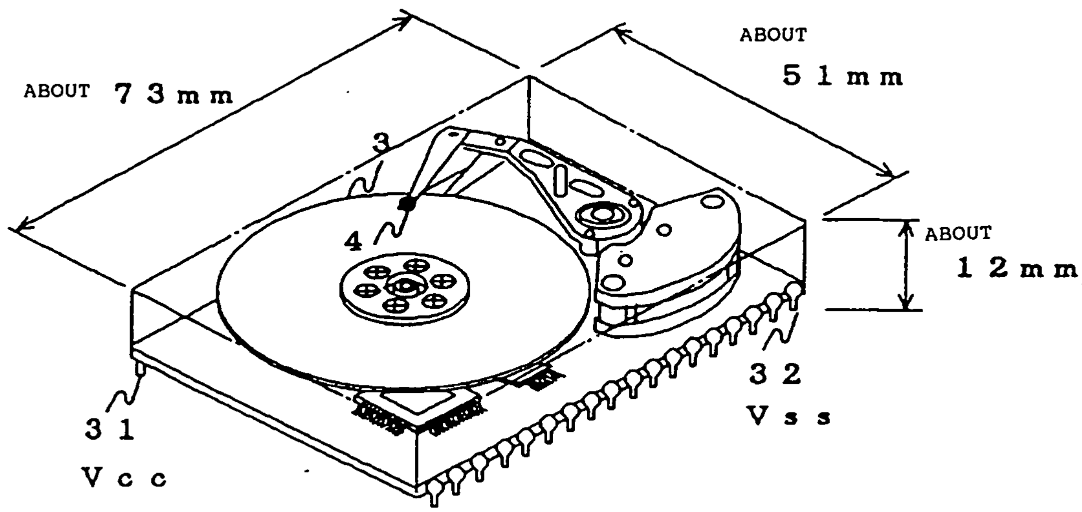

FIG. 6

PERSPECTIVE VIEW 2 OF THE MICROMINIATURE MAGNETIC DISK APPARATUS

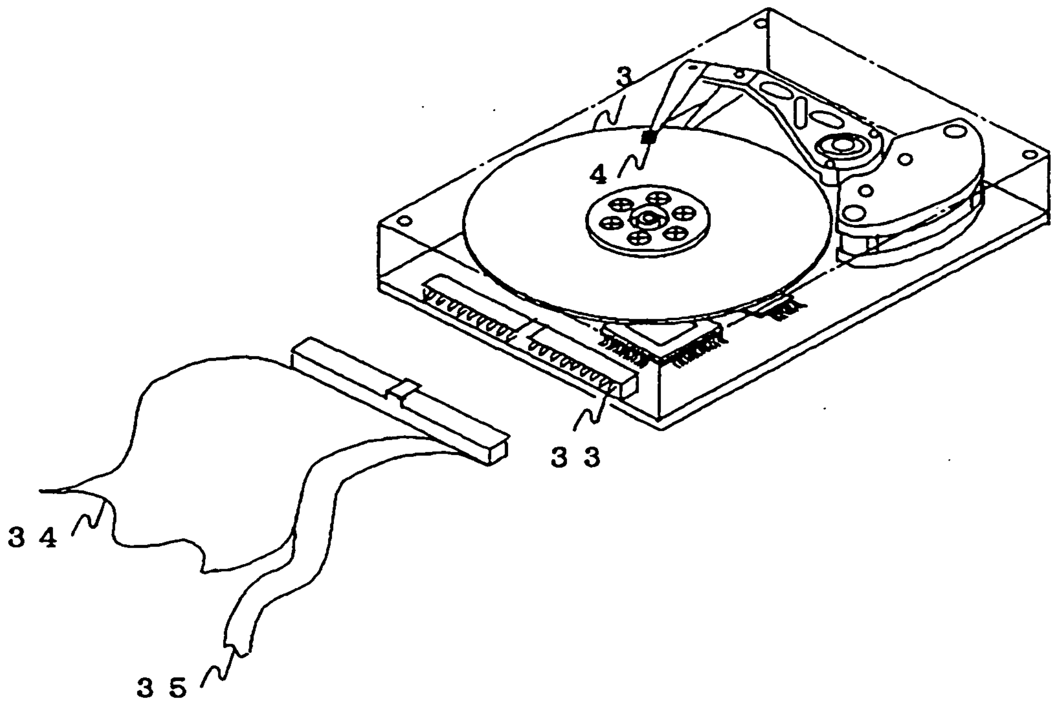

FIG. 7

STRUCTURAL VIEW OF A SPINDLE MOTOR OF THE MICROMINIATURE MAGNETIC DISK APPARATUS

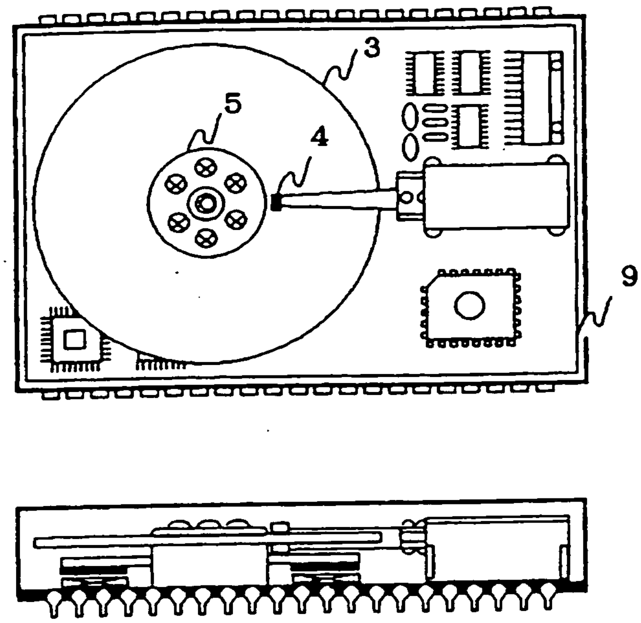

FIG. 8

EXPLODED PERSPECTIVE VIEW OF AN ELECTRONIC CIRCUIT BOARD OF THE MICROMINIATURE MAGNETIC DISK APPARATUS